TECHNICAL NOTES

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RIPARIAN REVEGETATION – TECHNOLOGY

This Technical Note is subdivided into the following Sections:

SECTION 11.1 WATERJET STINGER: A tool to plant dormant unrooted cuttings of willows, cottonwoods, dogwoods, and other species.

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Riparian/Wetland Project Information Series No. 17 describes how to build and operate a waterjet. This document (in full color) and similar publications from the Aberdeen, ID Plant Materials Center are available on the Internet.

http://plant-materials.nrcs.usda.gov/pubs/idpmcarwproj17.pdf

Most of the documents are in PDF format and can be readily downloaded.

SECTION 11.2 Photography: A basic monitoring technique for riparian ecosystem projects

Edelen and Crowder, 1997
Revised 11/2005

Visually effective monitoring

Photographs are worth more than a thousand words. In the case of riparian restoration, quantitative data is important, but a couple photographs can easily surpass field measurements in their ability to illustrate changes and communicate information. Photographs may not tell the entire story, but useful information can be gathered from repeated photographs taken at the same point over long periods. For example, stream bank modifications may take several years whereas riparian vegetation changes may be quite significant over periods of time and require frequent photographs.

Photographs should supplement quantitative data monitoring methods. Unfortunately, project coordinators frequently lack time, money and monitoring knowledge to collect and analyze quantitative data. Photographs at least provide a baseline inventory of the landscape and documentation on rates of vegetation change and events associated with that particular change. Visual extent of change, but not the cause of the change can be monitored (Bauer and Burton 1993).

Photographic monitoring is relatively inexpensive and easy to learn, but requires careful planning to generate meaningful information. The key is consistency. Photographs taken over time are only useful if pictures are:

1. Consistently taken from the same photo-plots.
2. Well-documented.
3. Stored in a systematic and easily accessible database.

The use of video cameras has increased. Some interesting approaches utilizing this technique have been developed. For example, storm events recorded on video cameras can uniquely document the effectiveness of vegetation for site protection (Bedell and Buckhouse 1993).

Methods

❖ ***Site Selection***

The establishment of permanent photo-plots should reflect project objectives.

> Example: A riparian revegetation project designed to stabilize stream banks, increase herbaceous and woody plant cover, and provides wildlife cover.

Potential photographs include stream bank profiles (cross-section) and representative landscapes. Monitoring these features can be accomplished by taking pictures before, during, and after project implementation. Subsequent photo-monitoring depend upon relative time-scales for changes to occur. Herbaceous vegetative growth may be significant within a season, whereas stream banks and woody vegetation may take several years to change.

❖ *General Photographs*

General photographs provide a representative view of the entire area and are necessary for documentation of large-scale changes. Distinct landmarks (mountain, boulder, telephone pole) in the background, preferably horizontal and vertical, assure the accuracy of repeated photographs in the future and serve as a reference point. General photographs can be divided into two categories: feature and landscape.

Feature photographs capture change of or around certain objects such as stream revetments or bank profiles. For example, in the case of monitoring stream banks, pictures form opposite sides of the stream, or upstream/downstream may provide the best locations for documenting change. Care should be taken to include some sky and a profile board to indicate scale (Figure 1).

> Procedure: Drive a steel stake into the ground 2 to 3 ft. approximately 30 to 40 ft. away from the object in each direction (upstream/downstream, opposite sides). The picture should be taken over the stake, with the other stake in the background and centered in the photograph. Reverse the procedure for the next photograph.

Landscape photographs encompass the entire area including any special feature. They may be taken from a nearby hill, bridge, road, or other easily found location. All photograph location sites should be well-documented for future reference.

❖ *Close-up Photographs*

Close-up photographs exhibit detailed site characteristics such as soil surface, herbaceous and woody plant cover, and organic litter. They can be taken from temporary plot locations, but are usually associated with permanent plot locations.

> Procedure: Mark off a 3ft. x 3ft. square with angle iron or rebar stakes at every corner (Figure 2). Paint the top half of the stakes with a bright color, such as florescent orange or yellow for easy relocation of the plot. Place a plot description at the bottom-center of the photograph. Lay a measuring tape across the south side of the plot to provide relative scale. The tape should be opened to 36 inches with the tape reading left to right. Step back approximately six to eight feet from the center of the plot to take the photograph. Mark the location of the plot on a map along with an arrow showing the direction in which you took the photograph. Keep a record of this with your files.

❖ *Analysis*

Photographs are usually intended to supplement quantitative monitoring methods. Slides and photographs can be compared over time to detect change (trends) in stream bank and riparian conditions.

Meyer (1987) developed a method for determining foliar cover for woody riparian species using a profile board and photographs. Refer to this document for further explanation of this method.

❖ ***Other Considerations***

- Photo identification should be in the upper right hand corner of the picture
- A camera tripod is recommended for steady clear shots.
- Bright colored stakes are easier to find
- Standing on north side of the plot will eliminate shadows across the plot.
- Photo-points should anticipate vegetation growth and potential for obscuring view.
- Landmarks should be permanent
- Do not use different lenses for subsequent shots (consistency)

❖ ***Successful storage of photographic files.***

Photographs of projects are often time taken and filed away without proper organization. Future referencing of photographs is frequently lost at this stage. Successful storage or photographic files depends heavily on the ease of data retrieval.

❖ ***Successful storage of digital photographic files.***

Like conventional photographs, digital photographs require proper organization. Electronic photograph files are subject to loss if maintained on a hard drive so it is very important to maintain external back ups on CD or flash drives.

<u>Procedure</u>:

1) Prepare a folder on the hard drive entitled -- PHOTOS. This folder can be subdivided into additional subject folders such as Projects, Landscape photos, Erosion photos, etc.
2) Store jpegs, tiff, etc. on the PHOTOS file.
3) Prepare a Word file on the hard drive entitled—PICTURE DESCRIPTIONS. This file needs to mirror the PHOTOS folder. Use an outline to create the mirror.
4) Each photo needs a description. For each photo stored in the PHOTOS folder, create a description. Be sure to use the same photo names used in the PHOTOS folders. The PICTURE DESCRIPTIONS.doc file can to be subdivided in the same fashion as the PHOTOS folder using an outline (Figure 3).
5) Use the PICTURE DESCRIPTIONS.doc file to store information. Such as: Date, photographer, location (sec, township, range), type of camera, landmarks, weather conditions, comments on vegetation and other conditions)

❖ ***Photo-point description label***

A description label should be filled out for each conventional photograph and include the following:

Project name and number
Date
Photo-point number
Time of day

References and Additional Reading

Bauer, S.B. and T.A. Burton. 1993. Monitoring protocols to evaluate water quality effects of grazing management on western rangeland streams. United States Environmental Protection Agency, Water Division, Surface Water Branch, Region 10, Seattle, WA. pp. 145-148.

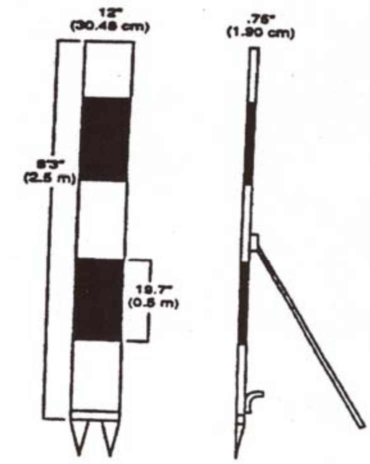
Bedell, T. and J.C. Buckhouse. 1993. Monitoring primer for rangeland watersheds. United States Environmental Protection Agency, Water Division, Surface Water Branch, Region 10, Seattle, WA. pp. 37.

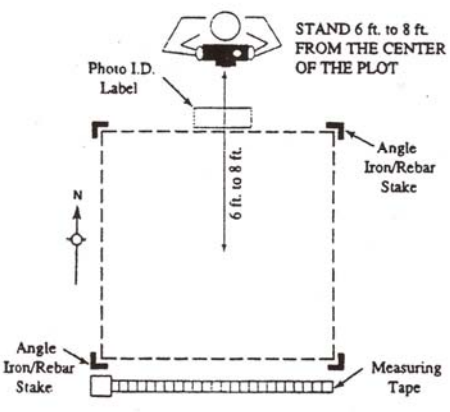
Harper, J., George, M., and K. Tate. 1996. Photo points as a monitoring tool. UCCE Rangeland Watershed Fact Sheet No. 16. Internet: http://www.ucop.edu/anrhome/coop-ext/Uccelr/h16.html.

Myers, L.H. 1987. Montana BLM riparian inventory and monitoring. Riparian Technical Bulletin No. 1., BLM-MT-PT-88-001-4410, Billings, MT. pp. 37.

Governor's Watershed Enhancement Board. 1993. Photo plots, a guide to establishing points and taking photographs to monitor watershed projects. Salem, OR.

Figure 1. Vegetation profile board. One-third meter by 2.5 meter plywood board marked in 0.5 meter intervals of alternating black and white.





Paint the stakes with bright-colored permanent spray paint (yellow or orange) to aid in relocation. Repaint these stakes when subsequent photographs are taken.

Figure 2. Close-up photograph utilizing a 3 x 3 ft square plot with angle iron or rebar stakes at every corner.

Figure 3. PHOTO DOCUMENTATION (example)

PHOTO FOLDER SYSTEM

Main folder Sub folder File name

C: PHOTO
- CRAB CK
  - Spillway 05-1:
  - Spillway 05-2
- WILLOW CK
  - Bank grading
  - Bank planting-1

PICTURE DESCRIPTION.doc FILE SYSTEM

A. CRAB CK Project
   1. Spillway 05-1:
      Date- 3/5/05
      Photographer- Jane Doe
      Location – SE1/4 sec 3, T5N, R5E, immediately south of Highway 2 bridge at mile marker 42.
      Camera- Nikon Coolpix 990, full zoom, UV haze filter
      Landmarks- Highway 2 bridge at Mile Marker 42.
      Weather conditions – sunny, 50 degrees, sun at my back.
      Comments- Note willow species shift at water's edge, spillway is upstream. Note plunge pool below spillway.

   2. Spillway 05-2:
      Date- 3/5/05
      Photographer- Jane Doe
      Location – SE1/4 sec 3, T5N, R5E, immediately south of Highway 2 bridge at mile marker 42.
      Camera- Nikon Coolpix 990, full zoom, UV haze filter
      Landmarks- Highway 2 bridge at Mile Marker 42.
      Weather conditions – sunny, 50 degrees, sun at my back.
      Comments- Note grasses established on 3:1 graded slope, spillway is downstream.

B. WILLOW CK Project
   1. Bank Grading
   2. Bank Planting-1

SECTION 11.3 Rooting Characteristics of Black Cottonwood and Pacific Willow.

Stannard and Guenther, 1999

Black cottonwood and Pacific willow are frequently recommended for planting along stream corridors in the Pacific Northwest. Most streambank plantings utilize dormant, unrooted cuttings of varying lengths. Unrooted cuttings are an efficient means of planting large numbers of plants but their successful establishment hinges on rooting. The Pullman PMC conducted a series of rooting trials to generate information on the rooting characteristics of black cottonwood and Pacific willow. Hybrid poplar cuttings were also used for rooting comparison in two studies.

Key results of the trials:

- **Black cottonwood rooted poorly on wood older than 3 years old.**
- **Pacific willow rooted better than black cottonwood.**
- **Older wood produced more aboveground growth but not necessarily more root growth.**
- **Black cottonwood 1-year wood cuttings taken from native stands rooted as well as nursery grown plants. Nursery grown plants rooted better than native stand cuttings when the wood was older than 1 year old.**
- **Black cottonwood did not root in standing water. It rooted at the capillary fringe.**
- **Pacific willow rooted in standing water.**
- **Hybrid poplar generally rooted very rapidly but varied with genotype.**
- **Hybrid poplar 1-year wood rooted more rapidly than 2-year wood.**

Trial # 1 Age of Wood Comparison

Cuttings of Black cottonwood that originated from the Tucannon River were obtained from the WACD nursery in Bow, WA and from the native stand on the Tucannon. Cuttings of Pacific willow originating from Spokane County were provided from the WACD nursery. Wood was separated into four lots: 1-year wood, 2-year wood, three year wood, and 4-5 year wood.

Three hybrid poplar accessions were provided by the Spokane Conservation District. Wood of the hybrid poplars was separated into 1 year wood and 2 year wood (older wood was unavailable). All cuttings were cut to 12-inch lengths. Cuttings were planted into a well-drained greenhouse potting mix in the PMC greenhouse and allowed to grow for 28 days. The potting mix was carefully washed from the roots on day 28, roots counted, and top growth weighed.

Species	Source	Wood Age	Number * Of Roots	Top Growth ** Biomass (gm/cutting)
Cottonwood	WACD	1	12.5	0.31
Cottonwood	WACD	2	9.5	0.95
Cotton wood	WACD	3	2.0	1.00
Cottonwood	WACD	4	6.0	1.61
Cottonwood	Native	1	18.5	2.46
Cottonwood	Native	2	3.5	0.86
Cottonwood	Native	3	1.5	1.55
Cottonwood	Native	4	1.0	1.99
Willow	WACD	1	18.5	0.55
Willow	WACD	2	26.5	1.44
Willow	WACD	3	21.0	4.18
Willow	WACD	4	19.0	4.73
Hybrid Poplar	50-197	1	26.5	3.68
Hybrid Poplar	50-197	2	4.0	0.78
Hybrid Poplar	OB-367	1	21.0	4.51
Hybrid Poplar	OB-367	2	9.0	1.42
Hybrid Poplar	15-029	1	8.0	0.91
Hybrid Poplar	15-029	2	5.5	2.35

* Root numbers values are the median number of 10 cuttings.
** Top growth means (dry weight)

One year and 2-year wood provided the best rooting of the black cottonwood. The best cottonwood rooting was observed for the native 1-year wood. However, the difference between its rooting and the WACD nursery grown cuttings was not statistically significant (Wilcoxon-Mann-Whitney test of nonparametric data at the 5% level). Furthermore, the WACD nursery cuttings produced longer and much more branched roots than the native grown cuttings.

Top growth and root growth were not necessarily correlated. It was quite apparent that water & nutrient movement into the top growth could occur through the cutting base in the absence of roots. Thus, <u>rating survival of actual riparian field plantings should NEVER BE based upon evidence of live top growth in the first year</u>.

Roots of 3-year wood of black cottonwood (left) and Pacific willow (right).

Rooting of hybrid poplar was highly variable and can be attributed to the parentage of the hybrid lines. Accession #50-197 rooted much better than accession 15-029. One-year wood clearly rooted better than 2-year wood. One-year wood has some distinct advantages for propagating hybrid poplar:

1) One-year wood is small in caliper and weighs little so a bundle of 100 cuttings are physically easier to handle than larger, heavier older wood.
2) One-year wood is very easy to produce.
3) One-year wood tends to develop apical dominance faster

Trial # 2 Effect of Cutting Submergence on Rooting

Black plastic was stretched over the top of 3-gallon plastic buckets that were filled with water. The covered buckets were allowed to stand for 48 hours to reduce the amount of dissolved oxygen in the water. Cuttings were then poked through slits made in the black plastic with approximately 10 cm of each cutting protruded above the water. The cuttings were allowed to grow in the greenhouse for 28 days. Roots were counted on day 28. The black plastic prevented light penetration into the water eliminating any potential oxygen production via photosynthesis thus helping to maintain a low oxygen environment.

Neither WACD nor native black cottonwood rooted in standing water. This can be attributed to the lack of oxygen which is required for root respiration. There was some callusing along the stems. Even though no rooting had occurred, the cuttings produced ample amounts of foliage.

Pacific willow rooted in standing water. Willows have the ability to transport oxygen from the stems to the roots unlike most other tree species. Rooting was not prolific. This could be attributed to energy reserves in the cutting being largely directed to the production of foliage rather than roots.

Trial # 3 Effect of Dropping Water table on Rooting

Cuttings were placed in 3-gallon plastic buckets filled with coarse gravel. Water was added to each bucket and a water line was maintained at a height of 3 cm below the top of the gravel. This “high water table” condition was maintained for 21 days. On day 22, holes were drilled in each bucket 18 cm below the top of the gravel thus dropping the “water table” by 15 cm. This low “water table” was maintained for 14 days. Roots were counted, weighed, and top growth weighed on day 35.

Almost all of the cuttings produced roots at 3 cm where the water line was maintained for 21 days. Black cottonwood roots occurred at the 3 cm capillary fringe but did not extend into the anaerobic, water-saturated gravel. When the “water table” was dropped 15 cm, these roots were left “high and dry” and were dead by day 35. No black cottonwood roots were produced at 18 cm deep. It appears that root initiation of black cottonwood is a slow process. Rooting of black cottonwood in environments subject to rapidly dropping water table will be less than ideal. Other research has shown that rooting of black cottonwood is detrimentally effected by rapid water table declines (10cm drop/day). Efforts should be made to ensure that black cottonwood cuttings are not planted in environments where water and oxygen are limiting.

Willow produced roots at 3 cm but these roots extended into the saturated gravel. Furthermore, willow produced roots all along the below ground portion of the cutting. This indicates that rooting occurs regardless of location of the capillary fringe. Pacific willow might be a better tall stature species for planting in environments where high water tables prevail for most of the growing season. At the very least, Pacific willow should be included with black cottonwood on plantings to increase the chance of adequate density of tall stature trees.

All three hybrid poplar accessions rooted at 3 cm deep. A few cuttings of the 1-year wood even rooted at 18 cm. Roots at 18 cm were short and mostly unbranched, and probably produced after the “water table” was lowered to 18 cm. Accession 50-197 continued to be the most prolific root producer of the three hybrid poplars.

Species	Source	Wood Age	Roots at* 3 cm deep (number)	Roots at* 18 cm deep (number)	Top Growth (gm)
Cottonwood	WACD	1	8.0	0.0	0.56
Cottonwood	WACD	2	2.0	0.0	1.08
Cottonwood	WACD	3	2.0	0.0	0.68
Cottonwood	WACD	4	3.0	0.0	0.86
Cottonwood	Native	1	0.0	0.0	0.25
Cottonwood	Native	2	0.5	0.0	0.60
Cottonwood	Native	3	1.0	0.0	0.43
Cottonwood	Native	4	1.0	0.0	0.21
Willow	WACD	1	26.0	12.0	0.58
Willow	WACD	2	31.0	12.0	1.22
Willow	WACD	3	21.0	0.0	2.02
Willow	WACD	4	11.0	2.0	2.86
Hybrid Poplar	50-197	1	2.0	0.0	NM**
Hybrid Poplar	50-197	2	3.5	0.0	
Hybrid Poplar	OB-367	1	3.0	0.0	
Hybrid Poplar	OB-367	2	4.5	0.0	
Hybrid Poplar	15-029	1	17.0	7.5	
Hybrid Poplar	15-029	2	5.0	1.5	

* Root numbers values are the median number of 10 cuttings.
** NM = data not measured for the hybrid poplars

Rooting of the hybrid poplar cuttings was highly variable. Cuttings that utilized wood with the terminal bud removed rooted much better than those cuttings with terminal buds intact. This is a simple auxin source-sink relationship. Accession 15-029 rooted much better in the "water table" trial than in the trial utilizing a well-drained potting mix. It might be less sensitive to oxygen deprivation in the rooting zone than 50-197 & OB-367, or it might exhibit differential sensitivity to ethylene accumulations in a waterlogged environment.

Summary

The results of this greenhouse trial will not directly reflect results of actual field trials. These greenhouse trials were designed to evaluate rooting over a short duration (35 days or less). Rooting occurs over a longer duration in actual field environments but rapid rooting is crucial for successful establishment.

Several trials are underway evaluating rooting success of cuttings in actual riparian environments. The Pullman PMC in cooperation with WSU and Whitman County Parks Department has established a test plot along Paradise Creek. This trial compares several soil additives for enhancing water retention in the rooting zone of black cottonwood cuttings. Rooting hormone additive is being tested as well. Results should be available fall 2000. Field plantings of black cottonwood have been established along the Tucannon river and Asotin creek in southeastern Washington. Data from those plantings will be compiled and summarized by the PMS. The Corvallis PMC has field studies in progress that are comparing establishment of several riparian tree and shrub species.

References

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